

Cryogenic vessels — Materials —

Part 2: Toughness requirements for temperatures between $-80\text{ }^{\circ}\text{C}$ and $-20\text{ }^{\circ}\text{C}$

The European Standard EN 1252-2:2001 has the status of a
British Standard

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National foreword

This British Standard is the official English language version of EN 1252-2:2001.

The UK participation in its preparation was entrusted to Technical Committee PVE/18, Cryogenic vessels, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

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This British Standard, having been prepared under the direction of the Engineering Sector Policy and Strategy Committee, was published under the authority of the Standards Policy and Strategy Committee on 23 August 2001

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Cryogenic vessels — Materials — Part 2: Toughness requirements for temperatures between -80 °C and -20 °C

This European Standard was approved by CEN on 19 January 2001.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

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Contents

	Page
Foreword	3
Introduction	4
1 Scope	4
2 Normative references.....	4
3 Terms and definitions.....	4
4 Requirements for steels with specified yield strength ≤ 460 N/mm ²	5
4.1 General	5
4.2 Temperature adjustments	6
4.3 Procedure for base material lower than 10 mm thick	6
5 General test requirements	7
5.1 Sub-sized specimens.....	7
5.2 Sub-sized specimens for components from which it is not possible to extract specimens of section size equal to the reference thickness	7
6 Welds	8
7 Requirements for aluminium and aluminium alloys, copper and copper alloys and austenitic stainless steels.....	8
Annex ZA (informative) Relationship of this document with EC Directives	19
Annex ZB (informative) Case proposal — Technical justification for the temperature adjustment term	20
ZB.1 General	20
ZB.2 The brittle fracture concept	20
ZB.3 Assumptions for the calculation of the minimum operating temperature.....	21
ZB.4 Temperature adjustment term.....	22
ZB.5 Literature	22

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 268, Cryogenic vessels, the Secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2001, and conflicting national standards shall be withdrawn at the latest by October 2001.

For relationship with EC Directive(s), see informative Annex ZA, which is an integral part of this standard.

This document also supports the objectives of the framework Directives on Transport of Dangerous Goods. This standard has been submitted for reference into the RID and/or the technical annexes of the ADR.

Therefore, the standards listed in the normative references and covering basic requirements of the RID/ADR not addressed within the present document are normative only when the standards themselves are referred to in the RID and/or in the technical annexes of the ADR.

This European Standard is composed of the following parts:

EN 1252-1, *Cryogenic vessels — Materials — Part 1: Toughness requirements for temperatures below -80°C .*

EN 1252-2, *Cryogenic vessels — Materials — Part 2: Toughness requirements for temperatures between -80°C and -20°C .*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

The use of materials at low temperatures entails special problems that have to be addressed. Consideration has to be given, in particular, to changes in mechanical characteristics, expansion and contraction phenomena and the thermal conduction of the various materials. The most important property to be considered is the material toughness at low temperature.

1 Scope

This European Standard specifies the toughness requirements of the metallic materials for use at a temperature between -80 °C and -20 °C ensuring suitability for use for the cryogenic vessels.

Fine grain and low alloyed steels with specified yield strength ≤ 460 N/mm², aluminium and aluminium alloys, copper and copper alloys and austenitic stainless steels are covered by this standard.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 10045-1, *Metallic materials — Charpy impact test — Part 1: Test method*.

EN 288-3:1992, A1:1997, *Specification and approval of welding procedures for metallic materials — Part 3: Welding procedure tests for the arc welding of steels*.

3 Terms and definitions

For the purposes of this European Standard, the following terms and definitions apply:

3.1

minimum metal temperature T_M

the lowest temperature defined for each of the following conditions (see also 3.2 and 3.3):

- temperature during normal operations;
- temperature during start up and shut down procedures;
- temperature that may occur during possible process upsets;
- temperature that may occur during pressure or leak testing.

3.2

temperature adjustment term T_S

term relevant to the calculation of the design reference temperature T_R and dependent on the pressure induced principal membrane stress at the appropriate minimum metal temperature

3.3

design reference temperature T_R

temperature used for determining the impact energy requirements

T_R is determined by adding the adjustment T_S to the minimum metal temperature T_M :

$$T_R = T_M + T_S$$

All applicable combinations of the temperatures T_M and T_S shall be considered and the lowest possible T_R -value shall be used for the determination of the required material impact test temperature.

3.4

impact test temperature T_{KV}

temperature at which the required impact energy has to be achieved (see clause 5)

3.5

impact energy KV

energy determined from Charpy-V-notch tests performed in accordance with EN 10045-1

3.6

reference thickness e_B

thickness of a component to be used to relate the design reference temperature T_R of the component with its required impact test temperature T_{KV} (see Figures 1 to 5). The reference thickness e_B is based on the nominal thickness (including corrosion allowance) and shall be as defined in Table 6. For butt welded components e_B is the nominal wall thickness of the component at the edge of the weld preparation.

4 Requirements for steels with specified yield strength ≤ 460 N/mm²

4.1 General

This method, based on fracture mechanics can be used to determine the requirements to avoid brittle fracture in C, CMn, fine grain and low alloy steels with a specified minimum yield strength ≤ 460 N/mm².

In this procedure the impact test temperature T_{KV} is not equal to the design reference temperature T_R .

Parent material, welds and HAZ shall meet the impact energy KV and impact test temperature T_{KV} requirements in Table 1 for design reference temperatures T_R and reference thicknesses e_B . Values of T_R shall be calculated from T_M using the values of T_S given in 4.2.

For materials with a specified minimum yield strength > 310 N/mm² the impact energy at T_{KV} given in Figure 1 and Figure 2 shall be 40 J. Where 27 J is specified in the product standard, Figure 3 for the post-weld heat treated condition applies. For the as welded case with minimum yield strength in the range > 310 N/mm² and ≤ 360 N/mm² Figure 4 applies. For minimum yield strength > 360 N/mm² Figure 5 applies.

Table 1 — Impact energy requirements

Specified minimum yield strength of base material N/mm ²	Required impact energy KV (on 10 mm x 10 mm test pieces) J	Figure defining required TK_V	
		Non welded and post-weld heat treated	As welded
≤ 310	27	1	2
> 310, ≤ 360	40	1	2
	27	3	4
> 360	40	1	2
	27	3	5

4.2 Temperature adjustments

T_S is a temperature adjustment that can be used if the pressure induced principal membrane stress does not exceed the percentage of the maximum allowable design stress or 50 N/mm² given in Table 2.

Table 2 — Temperature adjustments

Condition	Percentage of maximum allowable design stress			Membrane stress ^b
	> 75 %; ≤ 100 %	≤ 75 %	≤ 50 %	≤ 50 N/mm ²
Non welded or post-weld heat treated condition ^a	0 °C	+10 °C	+25 °C	+50 °C
As welded condition and reference thickness < 30 mm	0 °C	0 °C	0 °C	+40 °C

^a Also applicable for equipment where all nozzles and non-temporary welded attachments are first welded to vessel components and these sub-assemblies are post-weld heat treated before being assembled into the equipment by butt-welding, but the main seams are not subsequently post-weld heat treated.

^b In this case the membrane stress should take account of internal and external pressure and dead weight.

4.3 Procedure for base material lower than 10 mm thick

Minimum T_R values are given in Table 3 for use when the base material is less than 10 mm thick and the testing temperature T_{KV} is 20 °C. The impact energy requirements are as specified in the relevant materials standards.

If these materials are to be used below the T_R values given in Table 3 the testing shall be performed in accordance with the relevant curve for 10 mm in Figure 1 to Figure 5. The required energies for the sub-sized specimens are given in Table 4.